The Northwestern MILLER

MILLING PRODUCTION SECTION

The Fumigation of Grain in Elevators

By R. T. Cotton, J. C. Frankenfeld and L. M. Redlinger

EDITOR'S NOTE: The research work reported in this article was conducted with funds authorized under the Research and Marketing Act of 1946. Dr. Cotton, the senior author, is senior entomologist in charge of the Manhattan, Kansas, field laboratory of the Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U.S. Department of Agriculture; Mr. Frankenfeld, formerly a staff member of the laboratory, resigned June, 1951; Mr. Redlinger is a member of the Bureau of Entomology staff.

THE demand for milling wheats that are free or relatively free from hidden infestation and the prospect that wheat stocks bearing appreciable insect contamination may be classed as fit only for feed make it imperative that greater care be taken to prevent insect infestation in stored grain from reaching dangerous levels.

Studies by H. H. Walkden, Bureau of Entomology & Plant Quarantine, reported in this journal March, 1951, have shown that field infestation of wheat by weevils in the Great Plains region is negligible. Grain stocks quickly become infested in farm storage unless they are properly cared for, and there is no assurance that newly combined grain will not be mixed with small lots of old grain before it is delivered to country elevators. When small quantities of infested grain, mixed with fresh grain, are loaded into elevator bins, conditions are ideal for the rapid spread of infestation throughout the bin. It is essential to take precautions, and as a preventive measure to fumigate every bin within a week or two after it is filled, if the grain is to be held for storage.

Many country elevators have wooden crib bins that are just as serious sources of insect infestation as are wooden farm bins. Unless these bins are cleaned and treated with a residual spray each year before newly harvested grain is placed in them, they may infest all grain passing through them. Operators of terminal elevators should recognize this fact and as a preventive measure should fumigate all grain received from line elevators.

Test with Standard Fumigants

In previous years it has not been necessary to obtain a complete kill of insect life in elevator wheat, since it could be marketed without penalty if the free-living insects were held below the level of two weevils or five bran beetles per 1,000-gram sample. These free-living forms are more easily killed than the immature stages within the kernels, so that dosages of fumigants giving an excellent kill of adults fail to give an equally good kill of the immature forms.

In order to determine the relative effectiveness of some of the common grain fumigants against the adult and immature stages of the granary weevil, a series of tests was conducted in elevators in Kansas City, Wichita, and Atchison. In these tests the modifying effects of grain temperature and moisture content were also considered. The effectiveness of each fumigant was determined by placing canvas bags containing samples of wheat infested with (a) granary weevil adults, (b) eggs and young weevil grubs, or (c) late larval or pupal stages at different levels throughout the bin as it was filled. After fumigation the bins were run for seven days before the bags were collected. The mortality of the adult weevils was then determined, and the samples infested with immature stages were held for emergence.

Table 1—Effectiveness of a Grain Fumigant Containing Ethylene Dibromide, Carbon Disulfide, and Carbon Tetrachloride Against Various Stages of the Granary Weevil. Dosage 1½ gal. per 1,000 bu., Grain Temperature 65 to 70° F.

Bushel level—	No. of adults emerging from grain samples containing Eggs or young larvae	Late larval or pupal stages	% Kill of adults
Bottom of bin	0	0	100
1,000	7	27	100
2,000	17	39	100
3,000	21	24	100
4,000	29	29	100
5,000	2	11	100
6,000	7	7	100
7,000	0	6	100
8,000	0	0	100
9,000	0	19	100
10,000	0	8	100
11,000	0	5	100
12,000	5	19	100
13,000	0	4	100
14,000	0	0	100
15,000	0	0	100
Top of bin	6	47	72

In the first test a standard fumigant containing ethylene dibromide, carbon disulfide, and carbon tetrachloride (fumigant No. 3) was applied at the customary dosage of 1½ gallons per 1,000 bu. The grain temperature was 65°-70°. The fumigant was applied with an automatic applicator that operated continuously while the grain was running into the bin. The results of this test, given in Table 1, show that a complete kill of adults was obtained in all parts of the bin except at the top, whereas immature stages survived at nearly all levels. Based on the old standards of the so-called commercial kill, the results obtained were excellent, but in view of the need for wheat stocks free from hidden infestation they were not satisfactory.

To study the effect of grain temperature on the effectiveness of a fumigant and at the same time to determine whether or not the dosages recommended by fumigant formulators are sufficient to do a good job, similar tests were conducted with the following grain fumigants:

(1) Carbon disulfide 20%, sulfur dioxide 2%, carbon tetrachloride 78%.

(2) Trichloroethylene 10%, benzene 12%, sulfur dioxide 3%, carbon tetrachloride 75%.

(3) Ethylene dibromide 6.6%, carbon disulfide 12.1%, carbon tetrachloride 81.3%.

(4) Ethylene dichloride 75%, carbon tetrachloride 25%.

(5) Ethylene dibromide 5%, propylene dichloride 35%, carbon tetrachloride 60%.

(6) Ethylene dibromide 5%, carbon disulfide 10%, ethylene dichloride 20%, carbon tetrachloride 65%.

(7) Ethylene dibromide 5%, ethylene dichloride 35%, carbon tetrachloride 60%.

In one series of tests, elevator wheat at temperatures ranging from 54° to 58° F. and with a moisture content of approximately 13% was fumigated at 1½ gallons per 1,000 bushels with all fumigants except the mixture of ethylene dichloride and carbon tetrachloride (No. 4), when 3 gallons was used. In all cases an extra 3 gallons was applied to the surface grain after the bins were filled. Two 4,000-bu. bins were treated with each mixture. One week after treatment the bins were turned and the sample bags containing infested wheat were recovered. The mortality of the adult weevils was determined immediately, and the samples infested with the immature stages were held in an incubator for possible emergence.

The results of these tests are shown in Tables 2 and 3. From Table 2 it can be seen that all fumigants except the mixture of ethylene dichloride and carbon tetrachloride (No. 4) gave an excellent kill of adult weevils in all parts of the bins except at the top. However, from Table 3 it is evident that in no case was the dosage sufficient to give a complete kill of the immature stages. Some of the mixtures gave better kills than others, but heavier dosages should have been used in all cases.

In another series of tests conducted in the same manner but in mid-

(Continued on page 18a)

Table 2—Effectiveness of Common Fumigants Against Granary Weevil Adults in Cold Elevator Grain. Dosage 1½ Gal. Per 1,000 Bu., Plus 3 Gal. at Surface, Grain Temperature 54 to 58° F., Moisture Content 13%

Fumigant	Bottom of bin	Per cent kill—Bushel level— 500-700	1,000	1,400-1,500	2,000-2,100	2,500	3,000
1	100	100	100	100	80	100	60
	100	100	100	100	100	100	76
2	100	100	100	100	100	100	100
	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100
	100	100	100	100	100	100	100
4*	100	96	76	100	96	100	100
	96	72	....	92	100	....	100
5	100	96	....	100	100	....	100
	100	100	....	100	100	....	88
6	100	100	....	100	100	....	60
	100	100	....	100	100	....	100
7	100	100	....	100	100	....	60
	100	100	....	100	100	....	60

*Dosage 3 gal. per 1,000 bu.

Table 3—Effectiveness of Common Fumigants Against the Immature Stages of the Granary Weevil in Cold Elevator Wheat. Dosage 1½ Gal. Per 1,000 Bu. Plus 3 Gal. at Surface, Grain Temperature 54 to 58° F., Moisture Content 13%

Number of adults emerging from grain containing (1) eggs and young larvae, and (2) mature larvae and pupae

Fumigant	Bottom of bin (1)	(2)	Bushel level— 500-700 (1)	(2)	1,000 (1)	(2)	1,400-1,500 (1)	(2)	2,000-2,100 (1)	(2)	2,500 (1)	(2)	3,500 (1)	(2)
1	6	1	26	11	22	3	5	5	16	2	19	15	4	13
	9	0	6	6	6	0	3	6	2	4	8	23	16	
2	0	3	0	0	0	0	0	2	0	0	2	6	19	35
	1	0	0	0	0	1	0	0	0	0	6	29	..	..
3	0	3	8	4	0	..	0	2	0	1	..	..	0	0
	0	3	0	2	..	..	0	9	9	6	..	..	6	14
4*	0	0	15	8	22	9	0	1	12	7	1	0	0	0
	46	27	15	9	..	..	12	20	8	4	..	..	9	0
5	23	11	24	21	..	..	4	9	0	1	..	..	4	5
	0	1	21	4	..	..	15	5	0	1	..	..	17	57
6	14	5	19	14	..	..	1	0	1	3	..	..	29	32
	1	1	11	2	..	..	0	3	0	0	..	..	18	27
7	0	0	10	6	..	..	5	7	0	..	..	..	35	42
	19	5	15	11	..	..	0	3	0	0	..	..	39	66

*Dosage 3 gal. per 1,000 bu.

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Chemists' Camerama

A Picture Report of the 37th Annual Meeting of the American Association of Cereal Chemists, Held at Hotel Adolphus, Dallas, Texas, April 20-24, 1952

Dr. H. K. Parker, Wallace & Tiernan Co., Inc., and Frank R. Schwain of Procter & Gamble Co., president and secretary, respectively, of AACC.

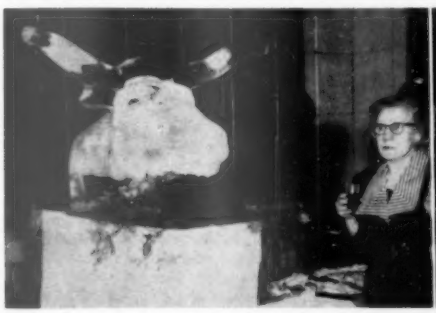
The above picture, taken in front of the exhibit of Merck & Co., Inc., Rahway, N.J., pictures R. B. "Jack" Potts, chief chemist for the Wichita (Kansas) Flour Mills (left), and C. G. Vaupel, Merck representative.

John W. Giertz (left) Kansas Milling Co., Wichita, and George W. Schiller (center) Hunter Milling Co., Wellington, Kansas, pictured in a conversation with Roland W. Selman, R. W. Selman & Associates, Kansas City, Mo.

Mrs. L. H. Pankey, Quaker Oats Co., Chicago; Samuel Clement, Monsanto Chemical Co., St. Louis, and Dr. Betty Sullivan, Russell-Miller Milling Co., Minneapolis, are pictured on the left. The center picture shows Dr. J. A. Anderson, president of AACC, pictured at the banquet, equipped with the paraphernalia given him by the Niagara Frontier Section, along with the "official" Buffalo to greet him. The picture on the left includes Mr. and Mrs. Pete Metcalf, Blaine Thompson Brokerage; C. T. Newell, Burrus Mill & Elevator Co., Ft. Worth, and Mrs. R. W. Zumwalt.

Pictured above is Dr. John S. Andrews, head of the food and nutrition research department of General Mills, Inc., Minneapolis, inspecting the grain X-ray exhibit of the General Electric Co., Milwaukee, Wis.

E. J. Rosse, Grain Products Testing Laboratories, Omaha; Lyle P. Carmony, Sterwin Chemicals, Inc., St. Louis, and Paul H. Towers, J. F. Imbs Milling Co., Belleville, Ill., pictured at the Sterwin Chemicals exhibit.



The picture on the left shows the Texas longhorn steer, sculptured in ice as a decoration at the president's reception. In the center picture are George L. Howard, Moore-Lowry Flour Mills Co., Coffeyville, Kansas; Mr. and Mrs. R. W. Pratt, Kansas City; Mr. and Mrs. Meade C. Harris, Chicago, at the annual banquet. The two young ladies, shown with Mr. Pratt in the picture on the left, are Myrle LaPlace and Betty Morring of Dallas, who were the flower girls for the Wallace & Tiernan Co., Inc., pinning carnation boutonnieres on the AACC delegates at the convention.

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"Right" or "Left"?

Break Roll Identification

By Henry Nelson

IT IS not to be expected that flour millers far removed from the cares of their work and responsibilities should wish to tax their minds exclusively with new and exciting subjects. I rather assume that you much prefer to talk about your common problems, to review among yourselves the subjects concerning the industry which you all know, or have known, or should have known, just to keep from being in a rut. Such a topic is "Break Roll Identification" which we have chosen to bring out of the closet for discussion.

The topic has two phases, namely: How to determine the "hand" of an ordinary double roller mill, and, the difference between fast and slow corrugated grinding rolls. Both have been thought of extreme importance in the past, particularly when replacing and re-corrugating worn rolls. In spite of being old our topic is still veiled in doubt and confusion. In fact it has been tossed about so long to no avail that the only reasonable thing left to deal with it seems to be to start all over again from the beginning, restate the present involved and conflicting definitions in a plain and logical manner and thus dispose of the problem once and for all.

There are in current use two conflicting rules for determining the hand of a mill. The oldest one, stated by Dedrick and indorsed by his contemporaries reads as follows: "To determine which is right or left hand, stand facing the mill on the side having the outside fast roll nearest to you. If the pulleys on the fast rolls are on the right, the mill is right hand; if on the left, the mill is left hand." You will notice now, that if you walk to the opposite side of the stand, facing the outside slow roll, the drive pulley on this slow roll must of necessity give you the same identical answer. Wondering about why you should have to worry about which is the fast and which the slow roll, when that is not what you want to know, and they both give you the same answer anyway, you may decide to refer to more recent literature and catalogs where you will find stated a different definition which reads as follows: "To determine which is right or left hand, stand facing the mill on the side having the outside slow roll nearest to you. If the pulleys on the fast rolls are on the right, the mill is right hand; if on the left, the mill is left hand." Obviously you may as well face the outside fast roll and obtain the same identical answer from the location of the pulleys on the slow rolls. It makes no difference.

Following a custom centuries old, I am in the habit of considering myself a right handed person, since my good right arm is attached to my right shoulder; but by applying the "reverse" rule, electing to face my front- rather than my back-side (and that, of course, is the whole secret of the switch), you people, a jury of millers, may now declare me a left-

(Continued on page 14a)

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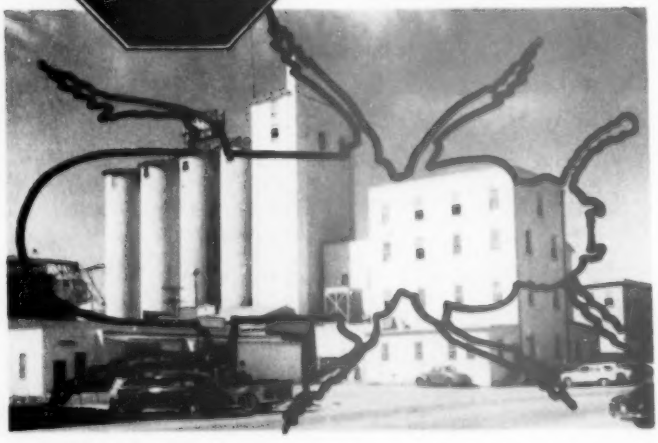

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Chemists Review Milling Technology Progress

A varied and informative symposium on milling technology was presented as one of the features of the annual convention of the American Association of Cereal Chemists at its 1952 convention, held at Dallas, April 20-24.

H. G. Obermeyer, General Mills, Inc., Minneapolis, presided at the session. Topics presented on the symposium varied from a unique photomicrographic study of the disintegration of a wheat kernel endosperm to an analysis of the intrinsic values of different wheat varieties for milling.

Better Cookie Flour From Break Streams, Kroger Chemist Says

R. C. Lakamp of the Kroger Food Foundation, Cincinnati, Ohio, presented the first of a series of studies on cookie flours. The report dealt with an analysis of the different streams in a mill with regard to suitability of the flours in making cookies. Mr. Lakamp said that the standard cookie flour test, that is, the ratio between the spread and the thickness of the cookie, improved as one progressed from the head to the tail of the mill in the use of the different streams. The break streams, he said, yielded better cookie flour than did the middlings stream. His report included chemical and test data of the cookies made from the different flour streams and it was shown that a better spreading cookie flour was milled by modifying the temper of the wheat so as to get a greater release of break flours and he said that these observations suggest that, for the production of cookie flour, the milling process might well be reviewed to see if revision of the flow and balance of the mill might contribute to a better performing flour. Mr. Lakamp reported that the analysis of the different mill streams by the use of the cookie test was suggested by the fact that flours from two mills drawing from substantially the same area for soft white winter wheat, varied significantly in their spread factors.

The report presented by Mr. Lakamp was prepared by George F. Garnatz, W. H. Hanson, and Mr. Lakamp, all members of the Kroger Food Foundation's staff.

Slow-Motion Pictures Show Disintegration of Wheat Endosperm

Dr. R. M. Sandstedt, Department of Agricultural Chemistry, University of Nebraska, Lincoln, showed a unique motion photomicrographic study of the disintegration of wheat endosperm when subjected to pressure. The motion pictures, he said, were taken through the microscope at 64 frames per second, thus producing in effect a slow motion picture as observed on the screen.

The pictures showed the differences in the way that hard and soft wheat endosperm particles disintegrate when subjected to a combination of pressure and shear. He compared the disintegration of the hard wheat endosperm to that of a piece of ice and it was plainly visible to the audience that the hard wheat appeared to be shattering or breaking off in very angular lines which, Mr. Sandstedt said, suggested that there were natural lines of cleavage in the cell wall structure of the endosperm.

The disintegration of the soft wheat endosperm, by contrast, appeared to be like that of a lump of compressed snow, since there was no general cleavage pattern visible in the photomicrographs.

Dr. Sandstedt said that it is possible to alter the characteristics of reduction between the hard and soft wheats by variation in the amount of tempering moisture applied.

Use of Pneumatic Conveying System as a Flour Dryer

J. H. Waldron, head of the Flour Milling Division of the Sprout-Waldron Co., Inc., Muncy, Pa., presented a discussion of the use of his company's "Pneu-Vac" system for the drying of flour. The Pneu-Vac system is a material handling system using air as the conveying medium and it was adapted for use as a flour drier with the addition of a heater at the air inlet to bring the air up to the proper temperature so that the moisture could be removed from the flour as it passed through the system.

Mr. Waldron said that the system was being used by the Maple Leaf

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Milling Co. at Toronto to lower the moisture content of flour being used in prepared cake mixes. He said that one pass through the conveyor dried flour down from the moisture content of 14% to approximately 10½% at a very low cost.

The capacity of the system, he said, was reduced somewhat when it was used as a drier because it was necessary to use a higher ratio of air to flour. Mr. Waldron's presentation also included a description of the mechanical features of the "Pneu-Vac" system.

* *

Monetary Difference in Economic Values Measurable in Wheats

The difference in value of poor and good wheats from the standpoint of milling quality was translated into dollars and cents figures by E. F. Seeborg of the Western Wheat Quality Laboratory, Washington Agricultural Experiment Station, Pullman, Wash., in a thought-provoking paper entitled "The Intrinsic Value of Milling Wheat." Mr. Seeborg, in prefacing his analysis, said that there are five chief milling factors to be considered in evaluating the merits of a soft wheat variety. The factors he listed were optimum rate of milling, optimum milling moisture, total flour yield, patent flour yield, and the ash content of the straight flour.

In presenting his analysis Mr. Seeborg dealt with a mill designed to grind 100 bu. of wheat an hour under average conditions. He showed that if, because of inferior milling characteristics, it was necessary to cut the rate of feed of the wheat to 90 bu. an hour, a drop of 10%, the difference in the rate of feed amounted to $52 per day. To show that that was not impossible he cited the Rex wheat variety in the Pacific Northwest. He said that with a straight Rex wheat mix on the mill the rate of feed would have to be cut to about 75 bu. an hour—a reduction of 25%. Translating it into milling costs, that reduction would amount to nearly $300 a day. Figuring it another way, Mr. Seeborg said, the intrinsic value of the good wheat which can be fed at the rate of 100 bu. an hour as compared with Rex at the rate of 75 bu. an hour is about 12.2¢ per bu.

With regard to milling moisture, the second factor, Mr. Seeborg said that if the optimum milling moisture content of an inferior variety of wheat is 2% lower than the optimum moisture of a good milling wheat and if half of the moisture difference appears in the flour, the economic loss due to the inferior milling wheat would amount to $60 per day of operation, or 2½¢ a bushel.

In discussing total flour yield, Mr. Seeborg cited the difference in flour yield between Elgin, a superior western soft wheat, with Rex, an inferior soft wheat. He said that the flour yield on Elgin with the Buhler mill was in excess of 75% as compared with about 69% for Rex. On the average, he said, Elgin will yield nearly 7% more flour and this percentage figure translated for the mill he used as an example would amount to about $308 a day, or an intrinsic difference of 12.8¢ a bushel.

Using the same two varieties again, Mr. Seeborg pointed out that Elgin would produce about 5% more patent flour as compared with Rex and this difference amounted to about 12% more flour through the patent streams in a day's time or an average of $110 for the day, and 4.6¢ a bushel in its intrinsic value.

Referring to the difference in ash contents of the two varieties, Mr. Seeborg said that Elgin has an average ash of .35% and Rex averages about .40%. These figures were translated into about $66 per day in favor of the Elgin variety or 2.8¢ per bushel.

In summarizing his talk Mr. Seeborg said that a comparative rating of 10 Pacific Northwest soft white wheat varieties with the use of a milling index formula as applied to the experimental milling data would mean a difference of about $900 a day.

"There is a difference of about 15 milling index points between the present commercial varieties in the Pacific Northwest as measured by our empirical methods," Mr. Seeborg declared.

"There is a general agreement among the millers that these ratings reflect the behavior of the varieties in their mills. Assuming the validity of our economic considerations we have estimated that a successful application of these factors to the breeding program of the new varieties on a national scale can increase the efficiency of milling by millions of dollars a year," Mr. Seeborg declared. He cautioned that unless recognition be given of these facts in the selection of wheat varieties his estimated saving to the industry would remain only a dream. Agronomists in the Pacific Northwest, he said, agree with the Western Wheat Quality Laboratory that these potentialities are very real and are "too great to ignore."

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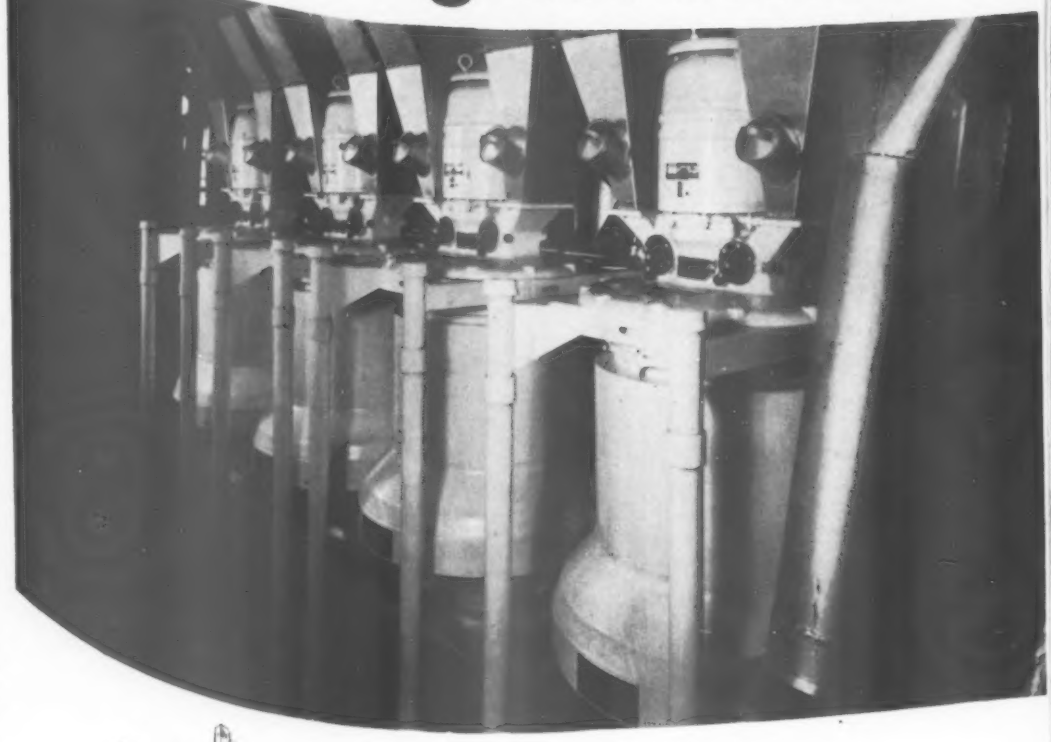

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Use of Impact Mills in the Flour Milling Process Reported

A review of the use of impact mills in the flour milling process and some preliminary reports of their further use was presented during the symposium on milling technology by Robert J. Hoskins, a research engineer with the Entoleter Division of the Safety Car Heating & Lighting Co., Inc., New Haven, Conn. Impact mills, he said, have been used in the break system in production of flour middlings and for a particle size reduction of finished flour.

The machine which has been used as an impactor during the past five years has been a modified Entoleter with an impact rotor which gave peripheral velocities up to approximately 14,000 feet per minute. The rotor contains 10 vertical blades and throws the stock against a corrugated liner containing teeth set at a special angle to deflect the impacted stock away from the impact zone, eliminating attrition action.

One of the features of impact milled flour as compared with flour produced on the conventional roller mill is that regardless of whether it was first break patent or sixth break patent, there was not a significant variation in either the ash or protein content of flour, Mr. Hoskins pointed out. The ash content varied between .39% in the fourth break and .43% in the first break. The protein content varied only .3 of 1% between the first and the sixth breaks, he pointed out.

In baking tests on the flour, Mr. Hoskins said, the absorption varied between 61 and 63% as compared with the absorption of 64% for a commercially milled sample of flour from the same wheat.

Slight reduction in loaf volume in the impact milled flour was noted in the slides presented by Mr. Hoskins.

Mr. Hoskins said that the resulting uniformity in both protein and ash contents of the impact milled flour was probably due to the impact mill action of breaking or "popping" chunks of endosperm free from the bran, rather than scraping it free as is theoretically and actually done by the corrugations of the conventional roller mill. He pointed out that the roller mill obviously always digs some bran along with the endosperm, particularly on the final breaks.

Mr. Hoskins showed a projection picture of a new design of impact mill having a 27-inch rotor. With this mill maximum impact velocities of 25,000 feet per minute are available when the rotor speed is 3,500 r.p.m. He showed projection slides to illustrate the effect of impact velocity on break release and said the impact velocity may be controlled by either variation of the rotor diameter while the machine is operating at constant speed or by the use of continuously variable speed drive with a constant rotor diameter.

Mr. Hoskins also showed slides of bar charts and graphs to illustrate the results obtained in the use of impact mills for the reduction of purified middlings whether they be produced from impact or roller mill.

The third part of his report dealt with the use of the new high impact velocity machine in reducing the particle size of finished flour, particularly on soft wheat flour for cakes. He said that perhaps the most significant result of this test was in the reduction in the blending time required for the cake batters. The original sample required 2½ minutes and all of the samples passed through the impact mill required 1 minute or less.

Mr. Hoskins also showed pictures of cakes baked from flours which had been passed through the impact mill in comparison with the cakes baked from flours which had not. The original flour gave a cake with a peak in the center and narrow at the edges. The cake from the impact milled flour gave close to maximum volume and produced a cake of more uniform thickness.

In closing, Mr. Hoskins said that "We hope this rather sketchy report on some of the more recent developments on impact milling has been of interest," and he explained that the lack of complete verification on the tests reported on the 27-inch machine is because the machine is so new and they have had barely time enough to do some preliminary investigating with it.

Cell Wall Thickness Described as Index to Milling Quality

Dr. M. J. Wolf of the Northern Regional Research Laboratory, Peoria, Ill., presented a technical report, "Characteristics of Endosperm Cell Walls in Relation to Milling Quality of Seven Varieties of Pacific Northwest Wheats." Dr. Wolf said that it was possible by measurement of these cell walls of a wheat variety to determine whether or not it could be classed as "good" or "poor" as regards its milling quality. He added that this measurement does not distinguish between varieties which are closely similar in milling quality.

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Instead of measurement of the cell walls with a microscope, he described a technique which involves the degradation of the endosperm to leave the walls open for staining with a biological stain, and then making microphotographs to see how much of the cell wall remained.

The utility of the test lies in its use by plant breeders in the early stages of variety development. It was pointed out that the test does not require a very large quantity of wheat and the variety could be tested in the early stages of its development.

Dr. Geddes Reports Role of Molds in Grain Respiration

Dr. W. F. Geddes, chief of the Division of Agricultural Chemistry at the University of Minnesota, in a technical paper presented on the milling technology session at the annual convention of the American Association of Cereal Chemists, said that information which has been gained and research conducted at the University of Minnesota has supplied direct evidence of the part that molds play in grain respiration.

Dr. Geddes said that the research was conducted on a sample of white wheat free from internal molds and further sterilized by surface disinfection. He said that the fact that the wheat was free from molds made it possible for the first time to compare the respiration of the grain itself with that of the same grain to which molds obtained from other wheats were added.

Respiration of the grain was normal at moisture contents of from 14½% to 15%, he said, but at moisture levels above that mark there was a large increase in the respiration of the grain and in the mold content.

Dr. Geddes observed that there was a direct parallel between the rate of respiration and the mold content of the grain. He did not say that the molds were involved directly in the respiration but added that the evidence to date has indicated further lines of research to determine any relationship between molds and sick wheat.

A definite relationship between the lipase production and the fat acidity value of sick wheat was observed. The free fatty acid contents of the moldy sample, he said, had increased about eightfold, while those of the nonmoldy samples were comparable with that of the wheat before storage.

Chemists familiar with the problem of grain storage and "sick wheat," in commenting on the paper presented by Dr. Geddes, said that the results of his research to date were "very significant."

* *

Cracks in Bran Coat of Weathered Wheat Aid in Tempering

A series of X-ray projection pictures, presented by Dr. J. A. Shellenberger, department of milling industry, Kansas State College, Manhattan, offered an explanation as to why weathered wheat is regarded by many millers as of better milling quality than unweathered wheat.

The X-ray pictures, which were made primarily for use in detecting hidden insect infestation in the wheat, indicated many small cracks or fissures in the aleurone layer at right angles to the crease.

These small cracks, invisible under normal inspection permit the ready entrance of tempering water to the endosperm, according to Dr. Shellenberger.

This rapid entrance of tempering water to the interior of the wheat kernel, Dr. Shellenberger explained, made possible the production of more middlings stock with a reduction of shattering in hard wheats. In addition, he suggested that perhaps it accounted for a better separation of the bran from the endosperm with a consequent higher yield of flour.

In X-ray pictures of both wheat and corn that had been dried with grain dryers, the fissures or cracks were more pronounced than in the naturally weathered and dried grain. Dr. Shellenberger said that it would be possible to induce artificial fissuring by wetting and then drying the grain, but added that the cost of that operation would exceed the added value to be gained.

The report on fissuring in weathered wheat was prepared by Dr. Shellenberger, Dr. Max Milner, and other members of the staff of the department of milling industry, Kansas State College, Manhattan.

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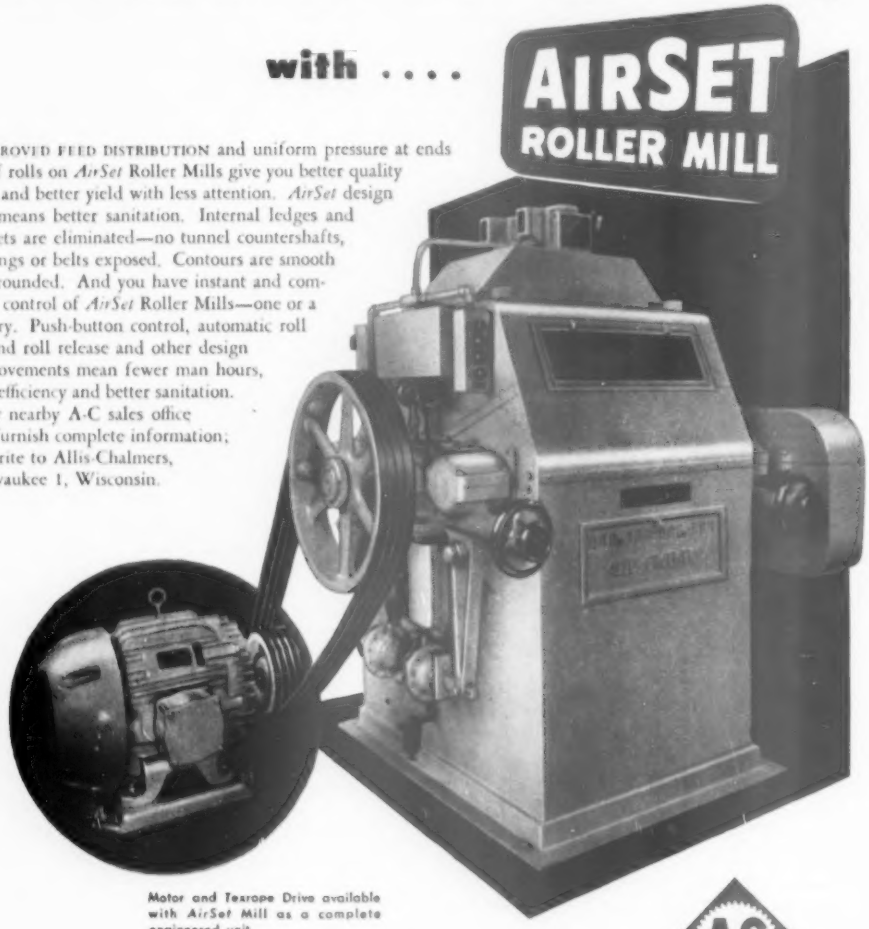

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AACC Plans Drive to Enroll Chemists in Feed Industry

DALLAS—Dr. H. K. Parker, Director of Research for Wallace & Tiernan Co., Inc., and president of the American Association of Cereal Chemists, in his presidential address delivered at the opening session of the organization's annual convention held at Hotel Adolphus, Dallas, April 20-24, recommended that the association devote some attention to the problems connected with products control in the formula feed industry.

He said that the organization has attempted in the past 12 months to interest control chemists in the formula feed industry and that a committee, headed by S. F. Brockington, had made some progress. He said that there has been enough interest aroused to obtain comments from some of the feed authorities and he recommended that efforts be continued to solicit the membership of this group of chemists.

Another specialized field he referred to as being worthy of further attention was the prepared mix industry. Dr. Parker said that there were 174 representatives of the industry who attended a special symposium on prepared mixes, held last December in St. Louis.

Regarding membership in the association, Dr. Parker said that the present membership is about 850 and that the increase in membership of 10%, set last year as a goal, was not achieved but that a satisfactory gain had been made.

He announced that C. L. Brooke, Merck & Co., Inc., Rahway, N.J., had accepted the assignment to prepare, at the beginning of each year, a summary of the highlights of advancements and accomplishments on world wide basis in cereal chemistry to be presented by the association in its publications.

Mr. Parker also reported that it had been proposed that the executive committee be enlarged by a few members. This proposal was made in answer to some criticism that "power organization is controlled on too centralized a government and there is danger for a clique to perpetuate itself in power." He felt that an enlarged executive committee might be an answer to the criticism but he feared that if it got too large, it would become unwieldy and inefficient.

The problem of continued support to Biological Abstract was discussed by Dr. Parker and he said that the association has as of now contributed $10,000 to the support of the abstracting service. He reported that the chairman of the abstracting service committee urged that this support be continued even though it is used by about 15% of the organization's total membership. Dr. Parker said that it was his personal feeling that some sort of an abstracting service should be maintained by AACC and he doubted that the organization could get as good coverage or service from some other source if it withdrew its support from Biological Abstracts.

A membership directory will be published by the association, Dr. Parker reported, in saying that the executive committee felt that the benefits to be obtained from such a directory greatly exceeded the disadvantages (which he did not list). He said the last directory of the association was published in 1929 and it is, of course, "greatly out of date."

The directory will be prepared by the office of the managing editor of the association's publications.

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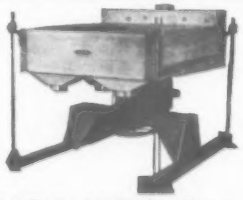

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FDA Regulatory Activities Involving Grain in Storage

By Chester T. Hubble
Food & Drug Administration, FSA

EDITOR'S NOTE: The accompanying article is a part of the text of an address delivered by Mr. Hubble at the recent state convention of the Ohio Farmers Grain Dealers Assn. Mr. Hubble is chief of the Cincinnati District of the Food & Drug Administration, Federal Security Agency.

* *

An investigation of storage conditions in country and terminal elevators has shown that elevator storage in many cases is responsible for contamination of grain. This problem must be faced and solved, therefore, if millers are to furnish the public with clean, wholesome products that comply with the requirements of the law commonly known as the Pure Food and Drug Act.

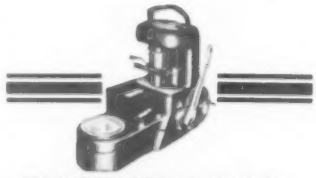
Your national association has already undertaken in cooperation with us an educational program to acquaint you with our activities and objectives. This has been in the form of a series of bulletins entitled "National Grain Sanitation Program" and captioned "Committee Action." You were designated therein as bankers for the nation's food just as a bank is custodian for our cash. You were told about your bank robbers—the rats, mice and insects! Specific objectionable conditions actually encountered by us were described under some such caption as "Chamber of Horrors." You were warned as to the corrective measures needed.

Many of you can expect a Food and Drug Inspector to call on you, identify himself, and examine your grain, obtain information as to its history, and make a thoroughgoing sanitary inspection of the entire building or buildings and premises. He will look for sources of contamination such as infested grain residues in the bottom of bins, on ledges or crossmembers in bins, on gallery or headhouse floor, on catwalks across open bins, in elevator boots, horizontal conveyors, dump pits, or grain handling equipment. He will look for and report any evidence of contamination by birds and the telltale rodent pellets and runways indicating rodent infestation. Photographs may be taken and exhibits of contaminated products obtained. He will not overlook as a companion problem the possibility that rail cars spotted for loading may be a source of contamination due to infestation in walls or cracks.

At the conclusion of his visit the inspector will discuss his findings in detail with the most responsible official present at the time, and will make recommendations for correcting the objectionable insanitary conditions. He is not authorized, however, to name any particular fumigant or to go into exact details of changes in construction or specific methods for getting rid of the rodent or insect menace if it exists. You will be free to select your own methods, although I am sure the inspector will mention many preventive steps that will prove profitable to you.

In addition to operating a sanitary elevator and handling your food grains under sanitary conditions, it will be necessary for you to also bring pressure upon the farmer to do likewise, and to deliver only clean grain. It will obviously be wasted motion for you to remove infested stocks from bins and grain handling equipment and then accept infested grain from the farmer and put this grain through your cleaning equipment and into your clean bins. You should also be alert to the problems connected with taking in more grain than you can properly handle and holding it too long. I am sure you are aware of the substantial economic losses involved when it is necessary to divert your products for animal feeding purposes.

Except in unusual cases indicating gross carelessness, our initial sanitary inspections of elevators will be largely educational in nature, and only grain that is grossly contaminated will be selected for formal seizure action. Our long experience in food law enforcement, however, has shown that our educational programs,



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to be effective, must be accompanied by the penalties provided for by the act for those who do not voluntarily comply. As indicated earlier, these may take the form of seizures of the contaminated product, or prosecution of the parties responsible for its movement in interstate commerce or for its becoming contaminated after receipt in interstate commerce. Upon conviction a penalty as high as $1,000 or one year imprisonment or both may be imposed for each violation on first offense. Repeat or intentional violations may bring even higher penalties. Perhaps you have heard of some of the cases already terminated against elevators shipping cars plugged with screenings or pockets of wholly unfit grain.

In initiating the new phases of our proposed regulatory program we wish to be fair to all—consumers, millers and grain producers and handlers. We know that our final "clean food" objective cannot be reached overnight or without your cooperation. Likewise we know that conditions deemed reasonably satisfactory today may not be good enough to satisfy us next year. Therefore, in outlining our present program to you it should be taken to mean that we will expect continual progress toward the goal of furnishing only clean grain to the food processors. We sincerely urge your cooperation.

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HUTCHINSON, KANSAS—Frank Taggart has resigned as grain buyer for the Commander-Larabee Milling Co. at Hutchinson and has taken a similar position with the Farmers Cooperative Commission Co. here. His position with Commander-Larabee will be filled by George DeGraw, formerly an inspector with the Kansas grain department.

Use of Peroxygen Chemicals in Improving Gluten Quality

IN REGULAR flour mill practice, chemical treatments to improve the quality of the gluten in the wheat are applied not to the grain but to the flour. The agents used for this purpose may be nitrogen trichloride, chlorine dioxide, persulfates, bromates and the like. It does, however, seem feasible to obtain the necessary maturing effects by treating the grain prior to milling and in the course of the tempering operation. Because of the usual moisture differential between stored wheat and wheat ready for milling, the tempering operation in most cases has to raise the moisture level of the wheat to the accepted 14%, more or less, suitable for milling. If the water absorbed by the wheat during tempering is made the carrier for suitable maturing agents, useful maturing effects may be expected and actually have been observed.

In recent times only one patent has been granted dealing with the subject matter. This patent describes a tempering process in which the tempering solution comprises a mixture of water, formaldehyde, citric acid, monocalcium phosphate, potassium bromate and hydrogen peroxide. It is claimed that gluten qualities of

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various wheats are improved to a large extent by the patented procedure.

There are, however, indications that simpler means than described in this patent may permit satisfactory maturing during tempering. In one process, more recently introduced on an experimental basis, potassium bromate, much used as maturing agent for flour in the dough stage, is added to the tempering water. It is said that this will exert a maturing effect on the flour in the endosperm during tempering and also prevent a growth of microorganisms in the tempering apparatus.

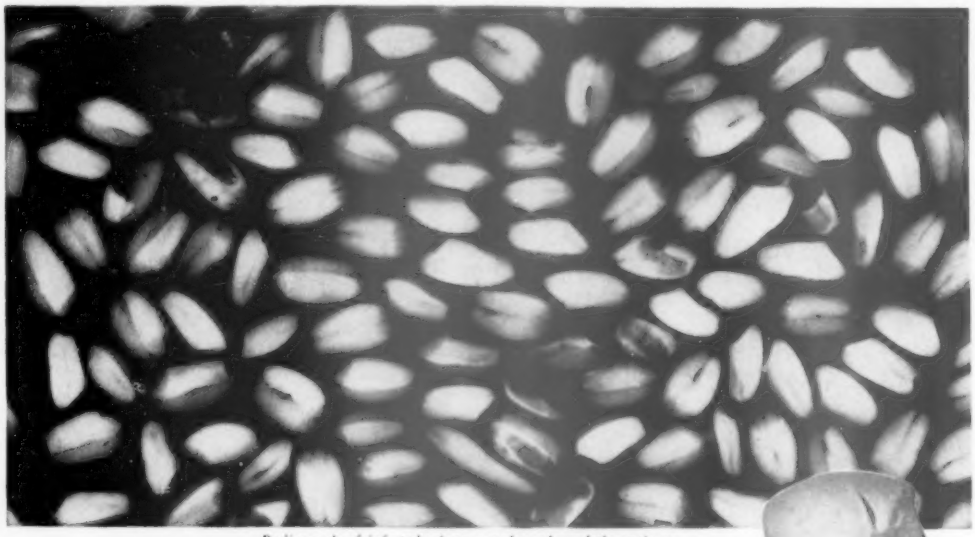
Flour maturing (in the dough stage) requires about 3 parts per million of bromate, or, disregarding the 20% weight difference between wheat and flour incident to 80% extraction, about 0.003 gram bromate for every 1000 grams of wheat. As these 1000 grams of wheat during tempering might take up an average of about 30 grams of water, a minimum concentration of 0.01% bromate in the tempering water would seem necessary.

The bromate solution would have to enter the kernel by diffusion through the seed coat, which represents a semipermeable membrane. Although information is available on the passage of water through this membrane, only isolated data exist pertaining to the passage of solutes. It seems that with many salt solutions the solute is adsorbed only on the surface of the seed coat, although in some cases actual permeability of the seed coat to individual salts has been observed. Generally, acids are absorbed by adsorbents to a greater extent than salts and it may be assumed that in the case of wheat, although its seed coat is interposed as a semipermeable membrane between the solution and the endosperm, passage of acids through the seed coat and subsequent absorption of the acid by the endosperm will be more generally observed than passage and absorption of salts. If this assumption holds, then the bromate present in the tempering water would give maturing effects not so much because of true absorption by the endosperm during tempering, but more because of adsorption on the kernel surface and mechanical carry-over through the milling process into the flour.

These considerations seem to indicate that hydrogen peroxide or peracetic acid in the tempering water might give maturing effects due to actual entry of the agent into the endosperm. Hydrogen peroxide added in very small amounts to the dough water does exert a definite maturing effect on the flour, comparable to the effects obtained with persulfate or bromate. Similar maturing effects were observed in exploratory experiments carried out many years ago, in which hydrogen peroxide had been added to the tempering water. It is rather improbable that hydrogen peroxide, if only adsorbed on the kernel surface, would carry over into the milled flour. Hydrogen peroxide would be expected to decompose under tempering conditions at such a rate that mechanical carry-over into the flour would not take place. Thus, maturing effects observed in the flour would almost certainly be due to a maturing effect exerted by the hydrogen peroxide during tempering.

There are reasons to expect that peracetic acid might be even more effective in producing maturing effects during tempering. In contrast to hydrogen peroxide, which suffers catalytic decomposition in presence of catalase and also when contaminated by dust, dirt and the like, peracetic acid is not affected by catalase at all and is less sensitive to contamination. Peracetic acid added to the dough water in amounts corresponding to approximately 6 parts per million of the commercial 40% solution, has a pronounced maturing effect on flour, comparable to the effects obtained with about 3 ppm. of bromate. Peracetic acid, added to the tempering water, might have similar maturing effects on the endosperm. Nothing is known about the permeability of the seed coat of wheat to peracetic acid, but it seems that acetic acid will pass through the membrane, in fact, passage of acetic acid through the seed coat of barley has been observed. All in all, the chemical and physical properties of peracetic acid seem to indicate that maturing effects by direct action on the endosperm might very well take place if minor amounts, perhaps about .02% of the commercial 40% peracetic acid solution, would be added to the tempering water. Moreover, even very dilute peracetic acid solutions possess high germicidal and fungicidal activity and disinfection of grain and equipment might also be expected.

EDITOR'S NOTE—A recent bulletin published by the Buffalo Electro-Chemicals Co., Inc., dealt with the general subject of seed treatment with peroxygen chemicals. The accompanying article is adapted from the bulletin, and deals with the use of peroxygen chemicals in the improvement of gluten quality of milling wheat. Publisher of the above-mentioned bulletin states in conclusion that "the information given is believed correct, but no warranty is expressed or implied regarding the accuracy of such information."



Radiograph of infested wheat sample, enlarged three times.

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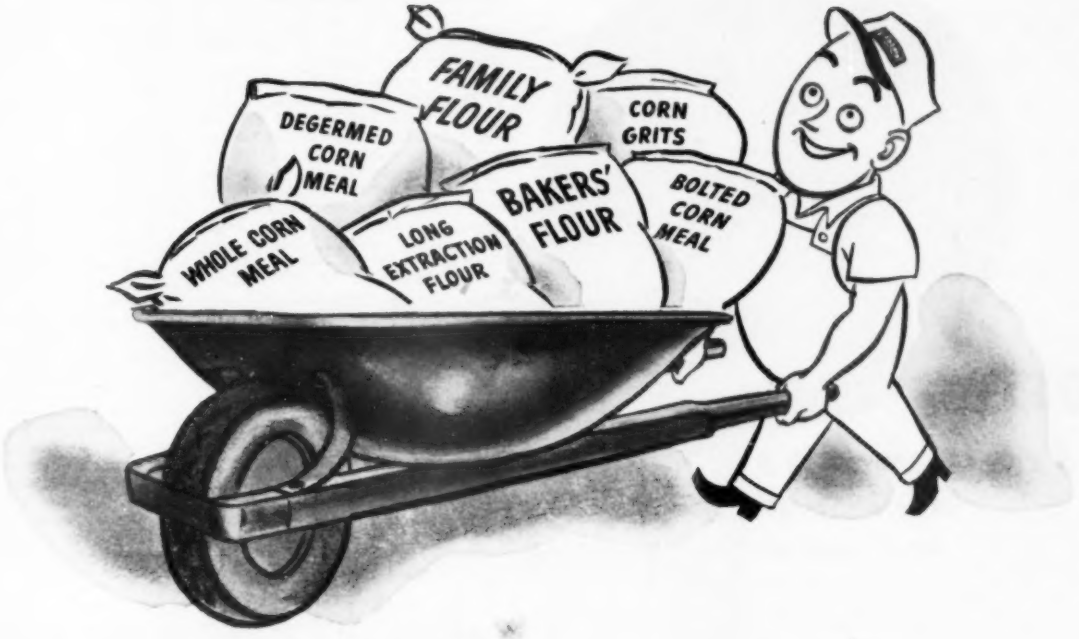

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Roll Identification

(Continued from page 4a)

handed person, since my most efficient arm is to your left.

It does seem a round-about way to be told to face a certain roll and then be made to name the hand of the mill after some distinguishing mark on some other roll you are not facing. Most people would shorten such a rambling rule to its substance and say: "A right-hand drive on the nearest roll gives you a left-hand mill." Such a rule is indeed unique, although it must be admitted in its defense that nature has provided one very powerful precedent for this topsy-turvy definition, namely your foot; for you will observe that a foot with a big (drive) toe on the right is the left foot, and vice versa; but this rule has been applied very little to feet since easier and more direct means of identification are known, so today it is only applied to grinding mills.

Some confusion has been added to the issue by the introduction of the fact that, using the first-mentioned or direct rule, the pulleys on the fast rolls always run clockwise in a right-hand mill. That they do, and so do the pulleys on the slow rolls in the same right-hand mill observed from their end of the stand. It seems more to the point to say that a mill is right-hand because the drive pulley of the roll you face is on the right side, than to say it is right-hand because certain pulleys move clockwise (or anti-clockwise for users of the "reverse" rule).

The two rules covering the same subject are in direct contradiction to each other: follow one rule and you have a right-hand mill; follow the other and the same mill is left-hand. How many millers and corrugators have declined to give up the old, more direct rule, or how many have yielded to the newer "reverse" rule is not known. It is apparent to many millers today, however, that the size of a pulley has no more to do with the "hand" of a mill than the size of the doorknob has to do with the "hand" of a door. They have found that all they need to do to make a correct determination, satisfactory to them, of the hand of a mill is just to face the mill on either side; if the pulley on the nearest roll is on the right, the mill is right hand; if on the left, the mill is left hand. That is all there is to it.

Our second problem is: What is the difference between fast and slow corrugated grinding rolls? As a pair of break rolls grind, the fast roll

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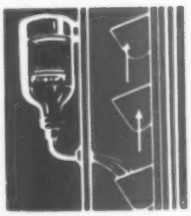


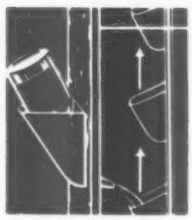
Fumaleg and 1 lb. bottle in "up" position.

● ***For Mills Using Larvacide in 1-lb Dispenser Bottles***

Attach Fumaleg by boring ¼ inch hole at convenient height in upside of leg on lower floor. With cap of Fumaleg facing downward, screw 1 lb. Dispenser Bottle into cap and leave bottle hanging until ready to turn legs—then swing bottle into "up" position, place wire loop over bottom of bottle and allow to drain. Stop machinery in two or three minutes.

● ***For Mills Using Larvacide in Cylinders***

Attach leg vase by boring ¼ inch hole at convenient height in upside of leg on lower floor. Draw out 1 lb. of Larvacide (9-10 fluid ounces) into pop or other convenient bottles. With legs turning for 2-3 minutes, invert bottles to vases, allow to drain.



Leg Vase with pop bottle.

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● ***Penetrates boot stock and tiny cracks***

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● ***Exposure time only 12-18 hours***

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turns about 2½ times faster than the slow roll. By inspection of the pulleys it is easy to tell which is which. But about the individual rolls —how do they differ? Let us examine a pair of corrugated break rolls. In making our examination, we will assume that these rolls have a sawtooth type cut with a right-hand spiral and the cutting action of the rolls is dull to dull, since this is a common way of grinding.

Aside from the length of the journals, we observe that the pair of corrugated rolls as installed in the stand are identical. This makes the spirals of the rolls cross where they almost touch, exposing the product to a shearing action. The spirals always cross, they cannot do anything else, no matter how the rolls are turned so we may forget about direction of spiral.

These two identical rolls have to be rotated from opposite ends, so we find that two identically cut rolls with the long journals at opposite ends make a pair. Nothing more. This, then, is the answer to our question. Other than the position of the long journal, there is no difference whatever between the fast and the slow roll; for they are made and cut to be alike; temper, corrugations, direction of the cutting of the corrugations, direction of spiral, etc., it is all the same.

Either roll is a "fast" roll or a "slow" roll according to circumstances. One roll of the pair is either the fast roll in a right-hand mill or the slow roll in a left-hand mill; the other roll is either a fast roll in a left-hand mill or the slow roll in a right-hand mill. Out of the pair, either roll will fit any stand as a fast roll; the remaining roll takes the position as the slow roll.

It follows that tagging a pair of break rolls right or left and fast or slow is quite unnecessary, since all you have is a pair of rolls; the only possible kind of a pair of rolls which will work in both right- and left-hand mills. When installing them, the miller knows where the fast drive is since he removed the drive pulleys from the worn rolls himself. He also knows which roll will work as the fast roll; instead of a corrugator's tag, he will use a rule somewhat like the following: When running dull to dull the sharp edge or "hook" is up on the fast roll.

By custom re-corrugated rolls are often required to be identified with location, corrugations, grinding action, hand and fast or slow roll respectively. However, since no roll is right-hand, left-hand, fast or slow, until it is placed in the stand, extra rolls may be used in mills of either hand as need arises where the roll action is dull to dull. Ignoring the markings "right" or "left" and "fast" or "slow," one need only follow the rule previously referred to, namely: "the hook is up on the fast roll."

I want to point out again that up to now we have assumed a dull to dull grinding action, which we consider the one most commonly used. There are however three other possible ways of grinding, namely: sharp to sharp, sharp to dull, and dull to sharp, which we now shall consider briefly.

Any pair of rolls running dull to dull can be made to run sharp to sharp merely by reversing them in the same stand. But for sharp to dull and dull to sharp action another pair of rolls must be used, namely, a pair of identical chills with the long journals, not at opposite ends as before, but at the same ends. (We are now looking at them on the floor; of course, one roll is swung around when installed.)

With the long journals at one end (again imagine them on the floor, not in the stand) you may have a pair which will run sharp to dull in a right-hand mill and dull to sharp in a left-hand mill. With the long journals on the other end you will have a pair which will run dull to sharp in a right-hand mill and sharp to dull in a left-hand mill.

It is apparent that, to indentify such pairs, two things must be known, namely, the grinding action (sharp to dull or dull to sharp) and the hand of the mill. Since the two rolls of each pair are identical, it is immaterial which is selected for the fast and slow positions; they will both work.

—BREAD IS THE STAFF OF LIFE—

Chemist From Finland on Tour of Research Laboratories in U.S.

MANHATTAN, KANSAS — A cereal specialist from Finland, Kalervo Mottonen, arrived at Kansas State College, Manhattan, recently to spend a month observing and studying the chemical analysis and baking procedure conducted by the department of milling industry and the research on treatment of insects in stored grain by the department of entomology.

The Finnish War Debt program this year selected Mr. Mottonen as the recipient of one of the special educational grants given each year to qualified persons in various industries within the country. The war debt program, set up by the U.S. government, converts Finland's World War I debt, which they are now paying, to funds for an educational exchange system whereby students and specialists from Finland can study in the U.S. With this grant, Mr. Mottonen was able to arrange

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for a four-month tour of the milling and baking industry in the U.S.

Mr. Mottonen has a degree in chemical engineering from the Finland Institute of Technology and has studied in Denmark, Sweden, England, Netherlands and Norway. He has been superintendent, manager and technical director of several chemical and cereal firms and has instructed in technical schools in Finland. His present position is head of the central laboratory, Vaasa Steam Mill Co., the largest milling concern in Finland.

During World War II, Mr. Mottonen served as a lieutenant in the Finnish army. He belongs to the Society of Finnish Chemists, the Society of Cereal Chemists in Finland, the Association of Engineers in Vaasa, Finland, and the Church Council in Vaasa.

When he arrived in the U.S. Feb. 1, Mr. Mottonen went directly to Washington, D.C., where the Department of Agriculture arranged a schedule for his tour in the U.S. He first visited the Whitmoyer Laboratories, Inc., in Myerstown, Pa.; then the University of Minnesota at St. Paul; the Annual Chemurgic Conference in St. Louis; the Association of Operative Millers and General Mills, Inc., in Kansas City, and Kansas State College.

After completing his study at the college, he attended the National Cereal Chemists convention at Dallas, Texas. He will visit the Northern Regional Research Laboratory, Peoria, Ill.; the Production & Marketing Administration and the Institute of International Education, in Chicago; and Wisconsin University, Madison, Wis. He plans to attend the A.O.M. convention in Buffalo and, finally, will stop at the U.S. Department of Agriculture in Washington before going to New York City where he will depart for home.

Kalervo Mottonen, cereal chemist from Finland, who is studying in the U.S., pictured as he inspects test loaves baked in the research laboratory of the department of milling industry, Kansas State College.

Mr. Mottonen remarked that he is very pleased with the reception he has received in the U.S. and he said the contacts in the institutions and companies he has visited were "very friendly and cooperative in supplying me with the information that I need to complete the purposes of my trip."

Spring wheat production in Finland is steadily increasing, he said, while the production of rye, until recently their most important grain, is now secondary. In 1939, about 90% of the wheat consumed in Finland was raised there, but since the war, that figure has decreased to around 40%. Much of the grain that must now be imported comes from Russia, some from Argentina and Australia, and a small amount from the U.S., Canada and France.

Most of the mills in Finland are rather new and have equipment containing the latest improvements. Pneumatic conveyors are becoming more popular in the mills in Finland, Mr. Mottonen remarked, and are used more than the conventional type of elevator most used in the U.S. The bread in that country is not thought of as being white and soft, but is usually made of rye and is dark and hard. Their mills contain a rather long flow, he said, and the flour is not enriched or bleached and is not as strong in gluten as the flour milled in this country.

—BREAD IS THE STAFF OF LIFE—

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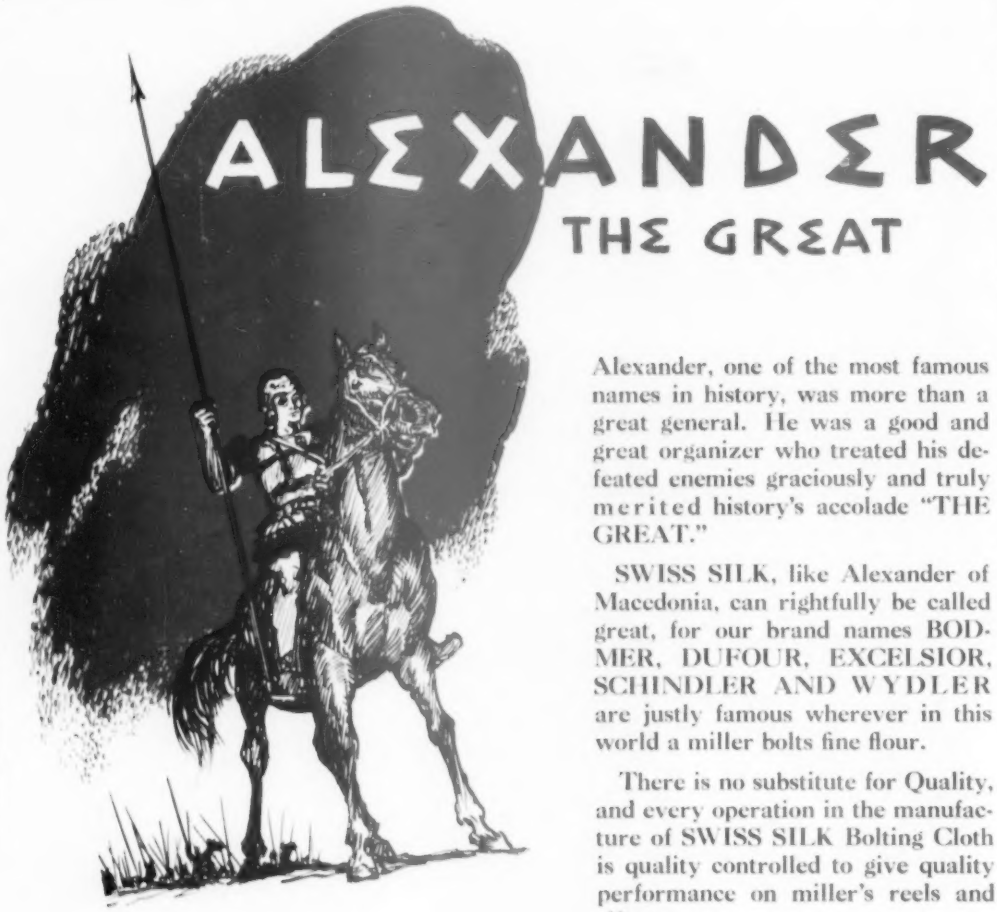

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Common Gear Types and Their Uses

In gear design, given two shafts which are to run on centers a specific distance apart, many different combinations of gears of different relative diameters may be designed to place on those shafts. Therefore, where speed of the driver shaft is established, the speed of the driven may be made nearly anything one chooses by controlling relative diameters of the pair of gears which will be used to connect the driven to the driver.

Not only so, but by making gears readily removable from both of two such shafts, many different pairs of gears can be provided for the same drive, having different relative diameters. By using a number of different pairs, the driven shaft can therefore have its speed adjusted through a large range of values, though the speed of the driver always remains constant. Such interchangeable sets of gears are much employed in machine design, and are known as change gears. While it is possible to use other than spur gears as change gears, spur gears are always most convenient, and are therefore practically always used for the purpose.

Where spur gears are used in various kinds of machine design, they are very often grouped or clustered quite close together, it being quite common to find two, three or more gears, having the same or different diameters, arranged side by side and concentric. In modern machine design, so-called "cluster gears" are used, which really embody two, three or more such gears all machined from a single piece of metal. This process has been made readily possible through use of the machine we know as the gear shaper, which has a short stroke, and therefore can be used to machine teeth of one gear at a time on a cluster, without any interference from other gears of the same cluster, whether they be larger or smaller.

Gears may be made from any metal which seems to lend itself particularly well for the duty in hand. Cast tooth gears are often used on applications where peripheral speed above 600 feet per minute or rotary speed over 150 R.P.M. is not required. Cut tooth gears are more accurate, and are of necessity used on higher speeds, though they are also preferred by many for lower speeds. Speeds as high as 1200 feet per minute may be safely negotiated on the periphery of cut gears. While it is possible to go above that speed in some cases, some form of drive other than a gear drive is usually to be preferred where required peripheral speed is greater.

Cast iron is about the weakest material commonly used for gears, if we exclude certain materials used in the interest of silent running. When a gear manufacturer is provided with the shaft diameters on which a pair of gears are to be mounted, with the speed at which the gears will run, and with the type of load to be carried (gears must be stronger where used in connection with shock loads), he can make definite recommendations as touching material from which the gears should preferably be made, whether their teeth should be cast or cut, and the face width the gears should have. Given gears of a specific material, made to a particular diameter, the amount of horsepower they will safely transmit will vary as the width of their faces. Thus, a spur with a 2-inch face (all other factors remaining constant) will safely transmit only half as much horsepower as one with a 4-inch face.

Another favored method of increasing the amount of horsepower a pair of gears will transmit is to use a stronger gear material. Thus, bronze gears will safely transmit considerably more horsepower than cast iron. Gears made of forged or cast steel will carry nearly 2½ times as much horsepower as cast iron gears. Nickel steel gears and other alloys may be employed for still higher strength if and when desired. Monel metal gears are quite often employed. These are highly resistant to corrosion as well as providing additional strength.

One thing overlooked in many cases is that different materials used for gears have different ratios of wear, as well as of strength. This is particularly important to consider in any case where a relatively small pinion is being mated with a large-diameter gear. If a small pinion and a large gear be meshed together, having been made of the same material, it is highly evident that the pinion will wear badly before any appreciable wear takes place on the gear, for each tooth in the pinion will function a number of times for each functioning of any given tooth in the large gear.

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Grain Fumigation

(Continued from page 1a)

summer, when grain temperatures were between 80° and 86° F., two elevator bins were fumigated with each of five of the fumigants tested in the first series. Grain moistures ranged from 12 to 13.6%. From Table 4 it can be seen that all the fumigants were highly effective against the granary weevil adults, and from Table 5 that they all killed a high percentage of the immature stages in all portions of the bins except near the top.

Tests were repeated with a number of the fumigants applied by the manual method in aliquot portions at the end of each 1000-bushel draft. The results were similar to those obtained with the automatic applicator.

To be on the safe side it is recommended that dosages of the common liquid elevator-grain fumigants be increased by one third when the grain temperature is 80° F. or above and by one half to two thirds when it is below 80° F.

Table 4—Effectiveness of Common Fumigants Against Granary Weevil Adults in Concrete Grain Elevators. Dosage 1½ gal. Per 1,000 Bu. Plus 3 Gal. at Surface, Grain Temperature 80 to 86° F., Moisture Content 12 to 13.65%.

Fumigant	Bottom of bin	Per cent kill—Bushel level 708	1,400	2,100	2,800
1	100	100	100	100	100
	100	100	100	100	100
2	100	96	100	100	100
	100	100	100	100	100
3	100	100	100	100	80
	100	100	100	100	100
6	100	100	100	100	100
7	100	100	100	100	100

Table 5—Effectiveness of Common Fumigants Against Immature Stages of the Granary Weevil in Concrete Grain Elevators. Dosage 1½ Gal. Per 1,000 Bu. Plus 3 Gal. at Surface, Grain Temperature 80 to 86° F., Moisture Content 12 to 13.65%

Number of adults emerging from grain containing (1) eggs and young larvae, and (2) mature larvae and pupae

Fumigant	Bottom of bin (1)	(2)	Bushel level 708 (1)	(2)	1,400 (1)	(2)	2,100 (1)	(2)	2,800 (1)	(2)
1	0	0	0	0	0	0	8	0	Lost	Lost
	1	0	0	0	0	0	0	1	4	0
2	0	0	0	0	0	0	4	0	0	0
	0	0	0	0	0	0	Lost	Lost	8	12
3	0	0	0	0	0	0	0	0	18	4
	0	0	0	0	0	0	0	0	0	0
6	0	2	0	0	0	0	1	0	8	1
7	1	0	0	0	0	0	0	0	0	2

Tests with Calcium Cyanide

Several elevator bins were fumigated with calcium cyanide in order to compare the effectiveness of this material with that of the liquid fumigants. The fumigant was applied continuously into the grain stream as the bin was being filled. A dosage of 10 pounds per 1,000 bushels was used with double dosage for the first 500 bushels. The effectiveness of the fumigant against adult and immature stages of the granary weevil was determined in the same manner used with the other fumigants.

The results of a typical fumigation are given in Table 6. It will be noted that the kill of all stages of the granary weevil was complete except at the bottom of the bin. The bag of wheat at the bottom of the bin may have fallen in the hopper, where air leakage prevented the build-up of a gas concentration sufficient to kill the insects. In other tests with both 10 and 15 pounds per 1,000 bushels, it was observed that, when the flow of grain was occasionally halted and the applicataion of the calcium cyanide interrupted, the kill of insects was not always complete at the grain levels where the interruptions occurred. For the best results it is imperative that application of the fumigant be uninterrupted.

Table 6—Effectiveness of Calcium Cyanide Against the Granary Weevil in Grain Elevators. Dosage 10 Lb. for First 500 Bu. and Thereafter 10 Lb. Per 1,000 Bu. Temperature 77 to 86° F.

Bushel level	Per cent kill of adults	No. of weevils emerged from grain containing Eggs & young larvae	Mature larvae & pupae
Bottom of bin	16	0	10
1,500	100	0	0
3,000	100	0	0
4,500	100	0	0
6,000	100	0	0
7,500	100	0	0
9,000	100	0	0
10,500	100	0	0
12,000	100	0	0
13,500	100	0	0
15,000	100	0	0

Tests with a Mixture of Acrylonitrile and Carbon Tetrachloride

Interest in acrylonitrile as a grain fumigant led to the treatment of one bin with a mixture of acrylonitrile and carbon tetrachloride. The methods of application and testing were the same for the other liquid fumigants. The results of this fumigation, given in Table 7, show that at the dosage used the kill, while good, was not complete for the larval stages in the lower half of the bin.

The use of dry ice as a source of carbon dioxide for the fumigation of elevator grain has frequently been suggested. Although many previous tests had shown that it is difficult to retain a lethal concentration of carbon dioxide in a grain elevator of usual construction, a few tests were conducted in a modern concrete elevator. Pieces of dry ice the size of walnuts were applied to the grain stream just ahead of the grain tripper as the bin was being filled, and

Table 7—Effectiveness of a Mixture of Acrylonitrile and Carbon Tetrachloride Against the Granary Weevil in Elevator Grain. Dosage 3 Gal. for First 1,000 Bu. and Thereafter 1½ Gal. Per 1,000 Bu. Plus 3 Gal. at Surface, Grain Temperature 80 to 85° F.

Bushel level	Per cent kill of adults	No. of adults emerging from grain containing Eggs & young larvae	Mature larvae & pupae
Bottom of bin	52	0	29
1,500	100	0	0
3,000	100	0	8
4,500	100	0	1
6,000	100	0	1
7,500	100	0	0
9,000	100	0	0
10,500	100	0	0
12,000	100	0	0
13,500	100	0	0
15,000	100	0	0

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at 12-second intervals a cake of dry ice 12 inches square was added. Dosages ranged from 50 to 200 pounds per 1,000 bushels with another 400 pounds added to the top 1,000 bushels.

The efficiency of the fumigation was checked in the usual manner with bags of infested grain dropped into the grain stream. The kill of insects was unsatisfactory at all dosages tried. In the bin with the heaviest dosage the kill of adult weevils in the top half ranged from 24 to 80% and in the bottom half from 52 to 100%. The immature stages were not greatly affected, as emergence was heavy in all parts of the bin.

Table 8 shows the kill obtained at different levels throughout a bin treated at the rate of 200 pounds per 1,000 bushels. The temperature of the treated wheat was lowered from an initial 88°-93° F. to 81°-87° F. when the dry ice was added. The use of dry ice to lower the temperature of heating grain has been frequently suggested, but is not practical.

Table 8—Effectiveness of Dry Ice Against the Granary Weevil in the Fumigation of Elevator Grain. Dosage 200 Lb. per 1,000 Bu. Plus 400 Lb. at Surface. Grain Temperature 85 to 93° F.

Bushel level	Per cent kill of adults	No. of adults emerging from grain containing Eggs & young larvae	Mature larvae & pupae
Bottom of bin	92	1	7
400	92	5	25
600	84	7	26
800	100	0	0
1,000	88	9	30
1,200	100	0	17
1,400	84	7	25
1,600	64	7	18
1,800	69	5	29
2,000	52	7	17
2,400	64	5	30
2,600	100	1	9
2,800	76	4	23
3,200	72	3	32
3,600	92	2	24
4,000	88	6	21
4,500	92	8	28
5,000	92	1	2
5,500	92	6	26
6,000	80	3	28
6,500	80	6	57
7,000	68	10	36
7,500	72	17	56
8,000	72	4	28
8,500	76	6	39
9,000	80	13	43
9,500	68	18	28
10,000	60	13	23
10,500	64	16	31
11,000	60	22	43
11,500	36	28	44
12,000	72	11	31
12,500	64	15	36
13,000	44	17	35
13,500	40	19	34
14,000	28	18	44
14,500	24	19	39
15,000	56	11	48
15,500	36	18	54
16,000	28	22	34

The standard liquid fumigants for treating wheat stored in concrete elevators, when used at dosages recommended by their formulators, give a reasonably good kill of adult granary weevils under most conditions. They do not give a complete kill of the immature stages within the wheat kernels even under the most favorable conditions. The lower the temperature of the grain the less effective is the fumigant against these stages.

It is urged that dosages of liquid fumigants now recommended be increased by one-third when grain temperatures are 80° F. or above and by one-half to two-thirds when they are below 80° F.

Calcium cyanide at recommended dosages was found effective when grain temperatures were high and the fumigant was added to the grain stream without interruptions. When interruptions occurred the kill was not complete.

Dry ice at dosages of 50 to 200 pounds per 1,000 bushels of wheat was not a satisfactory fumigant for elevator grain and did not materially reduce the temperature of the treated grain.

A 1-9 mixture of acrylonitrile and carbon tetrachloride gave good results but did not kill all insects in the lower part of the bin.

S-t-r-e-t-c-h the Life of Your Trucks

★ ★ ★

A GUIDE TO VEHICLE OPERATION ECONOMY

By Arthur Roberts

BECAUSE truck operating and maintenance costs are increasing and because there may be a shortage of rolling stock due to the conversion of materials to defense projects, the feed dealer should see to it that his trucks are kept in the best of condition from now on. This requires, not only better supervision on the part of the dealer, but also better cooperation from his drivers to see that his trucks are operated most economically.

In driving a truck there are certain rules, which if followed, will result in more economical operation, better performance, longer life for the truck and greater safety. The dealer should make sure that his drivers know these rules. To get expert information on truck care, which

Experienced mill operators everywhere fumigate periodically with LIQUID HCN because it destroys insects, insect eggs and rodents in their hiding places. When properly applied by an Industrial Fumigation Engineer, LIQUID HCN assures a plant-wide clean-up of pests in a matter of hours.

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the dealer can pass on to guide his drivers in order to minimize delivery expense, we interviewed a number of supervisors of sizeable fleets in the Middle Atlantic states where truck travel is high. Their practical counsel will help the dealer keep his rolling stock in tip-top condition at minimum cost.

Before a driver takes out his truck in the morning, he should check the horn and lights, see that the tires are properly inflated, that the instruments on the panel tell the right story on battery, oil and gas. Once on the road he should give the brakes a test to make sure they are operating properly. To save fuel, the driver should be cautioned to bring a truck, particularly when heavily loaded, up to maximum speed in the low gear, prior to any gear change, and to maximum speed in each succeeding gear before shifting. Some drivers have a habit of racing a cold engine in winter to warm it up. This wastes fuel and may score the cylinders. Idling the engine when the truck isn't running is another way to waste gas.

Driving habits are important. Some drivers drive fast, then slowly on the open road. They will get better gas mileage if they maintain a uniform speed. As speed increases, frictional and wind resistance increase to an even greater proportion. Wind resistance at 60 miles an hour is four times as great as at 30 miles per hour. Here is a typical example of the relationship between speed and fuel consumption, which shows that you can save fuel and minimize truck wear by driving at conservative speeds.

Miles per hour	Miles per gallon
30	12
40	10.5
50	10
60	8.3

The grade traveled influences fuel consumption and truck wear. If possible, the driver should be instructed to take the most level route when making deliveries. Jamming on the brakes instead of slowing down gradually wastes gasoline and causes unnecessary brake lining wear. Jumping ahead when the light changes eats up gas.

A lot of fuel is wasted and excessive wear placed upon a truck when the driver waits until the engine is practically dead before he shifts when driving up a hill. He should shift at the top of the speed range. For example, if he starts up a hill at 40, he should shift to a lower gear, not when the engine starts to pull, but while it is still going at better than its minimum speed in that range, say 30 miles an hour. In other words, shift at the "top speed" of each gear range.

Double Clutch

The fleet supervisors interviewed recommend the "double-clutch" when making an advancing gear change, so that the gear engagement is made properly, saving wear and tear on transmission and rear end. This consists of bringing the truck to maximum speed in the lower gear, releasing the clutch, shifting to neutral, re-engaging the clutch, releasing it again and then shifting into the higher gear.

This is done to synchronize the engine and vehicle speeds, so that when the clutch is released the second time, the engine will be operating at approximately the speed corresponding to that of the truck, and no clashing or grinding of gears will result. The same "double clutching" operation should be employed in shifting to a lower transmission ratio, except that it is necessary to increase the engine speed before shifting to the lower gear.

To save wear and tear on brakes, the driver should be counseled to use the engine to help brake the truck, to descend a hill in the same gear he uses to climb it. If necessary to use brakes, apply them off and on, not steadily. On slippery pavements, he should apply brakes with clutch engaged sooner than when streets are dry.

Holding the truck on a hill by slipping the clutch in wears out the clutch disc. Some drivers have this bad habit. Talk to them about it. A driver should keep his foot off the clutch pedal except when absolutely necessary. The habit of resting a foot on the clutch wears it our rapidly, tends to make it slip and wastes power and fuel bills. Accelerating before the clutch takes hold also causes undue clutch wear.

The engine is the heart of economical operation. Fuel economy depends to a great extent upon the ignition system, tire pressures, carburetor, engine compression, carbon deposits and the engine governor. The automotive experts gave us these helpful suggestions relative to these features, which we pass on to you to pass on to your drivers.

Once each month the distributor points should be inspected to make sure that the gap is set properly. The proper adjustment of all points of the ignition system is necessary for maximum fuel economy. All connections should be tight. Check the primary and secondary circuits and the coil. Remove spark plugs, check the electrode gap, and if necessary, set it properly. Watch for cracked porcelain. Clean plugs before replacing them in engine. See that the ignition wires are in good order, that they do not "leak" power.

Reports Important

In some instances, the driver can make these minor adjustments himself. Where this isn't feasible, the

dealer should have the work done by outside automotive servicemen. In either case, the dealer should get an immediate report on any operating defect. In too many instances, dealers do not instruct their drivers to report defects in truck operation, and a minor mechanical ailment continues until a big repair bill must be paid. Moreover, the truck is out of operation for a time and this is costly.

Breakdowns, when they occur, seldom happen in the garage, usually on the road with deliveries yet to be made. Breakdowns mean lost money, lost time and irritated customers. Then too, the dealer should remember that as more and more production is channeled into defense projects, truck parts may be hard to obtain and it may take much longer to make repairs, which will keep a badly needed truck out of operation for some time.

If the carburetor is not in good working order, fuel costs will be high. Make sure that the main jet of the carburetor has not worked loose in the carburetor bowl. If so, there will be fuel leakage around the jet. The height of the float level should be checked, because if it is too high, there will be fuel leakage around the carburetor bowl. When the engine is warm, set the "idle" so that the motor receives the proper fuel-to-air mixture on the "idle," and runs smoothly without rolling or loping. Leaky fuel lines are often responsible for high fuel consumption. Examine them periodically for leakage. Fuel consumption is also increased when there is a leaky cylinder head gasket and this should be checked during compression tests and replaced if found to be leaky.

Engine Compression

One of the main factors in fuel consumption is maintenance of the proper engine compression. A reduction in compression pressure, under the standard, indicates worn cylinder walls, defective piston rings, sticky valves or improper valve seating. The correct compression pressure for engines in good condition should be between 100 and 110 lb. per square inch at engine crank speed.

To check compression pressure, remove spark plugs from all cylinders. Insert compression gauge in the spark plug opening of each cylinder, one at a time and turn the engine with the starting mechanism. Measure the pressure of each cylinder separately. If the compression is below normal in one or all cylinders, perhaps the valves should be ground, or the cylinders need reboring and new pistons and rings fitted. While the head is off, remove carbon deposits.

Adding to Tire Mileage

The fleet supervisors interviewed stated that their records showed that you can add 25% to your tire mileage by inspecting the tires each morning before a truck starts out, by keeping the tires inflated to the pressure recommended by the manufacturer, taking into consideration the size of the tires and the weight of the maximum loads, by having the pressure actually tested once a week. Also remember that in hot weather the air in tires expands, raises the pressure, so don't put too much air in your tires on hot days. Avoid putting more air in the front tires than in the rear unless the distribution of your weight, front and rear indicates this should be done.

If you use chains in winter, don't fasten them on the wheels too tightly. You get better traction with loose chains and longer tire wear. Quick, jerky starts grind rubber off your tire treads. Avoid them. Also avoid sudden stops. When tires slide, it's the rubber, not the pavement that takes the biggest punishment. Tires wear out much more rapidly at high speeds. A moderate speed will add thousands of miles to tire life.

Check your wheel alignment every few thousand miles. When wheels are out of line, tires will wear rapidly and unevenly. If tires wear unevenly, change them around on the wheels so that the wear will be equalized. This prolongs tire life. Keep your truck in the shade when you park it. Sunshine and heat "burn up" miles of rubber. Spare tires are like human beings. They need exercise to keep in good condition. Put your spare tires on the truck at intervals and give them some exercise.

Inspect the battery every two weeks in winter, more often in summer because water evaporates quicker in hot weather. Keep battery terminals free from greenish corrosion deposits. Wash these off with soda and water, and grease lightly. This protects terminals and cable from "rotting." In summer, occasionally lift the hood and squirt a hose through the radiator core to wash out any insects that have clogged the core and grille. This increases the efficiency of your cooling system. If the water in your city is hard, mix a little water softener with it before putting into the radiator. This minimizes rusting and scaling.

It's cheaper to wear out oil than machinery. See that each truck is lubricated regularly with top-quality oil, but do not put more oil in the crankcase than you need. Too much oil won't lubricate any better—but it does add to cost.

We suggest that you have your drivers read this article or tack it upon a bulletin board for them to read. Unless they are expert automotive mechanics, they cannot be expected to make all adjustments and

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TRUCK AND COMMERCIAL CAR DAILY OPERATING RECORD

VEHICLE NO. DATE
VEHICLE MAKE DRIVER
MILEAGE IN TIME OUT
MILEAGE OUT TIME IN
1. DAY'S MILEAGE 2. TOTAL HOURS
3. TALLY OF LOADS, TONS, TRIPS, CALLS OR PROS — CHECK ITEM COUNTED — TOTAL

VEHICLE OPERATING EXPENSE

	NO. GALLONS	$
4. GASOLINE		
	NO. QUARTS	
5. OIL		
6. GREASING		
9. TIRES AND TIRE REPAIRS		
10. REPAIR LABOR		
11. REPAIR MATERIAL		
12. TOTAL		$

OTHER EXPENSES

13. WASHING	
14. STORAGE	
15. BODY REPAIRS AND PAINTING	
16. ACCIDENT EXPENSE	
17. MISCELLANEOUS EXPENSE	
21. TOTAL OTHER EXPENSES	$
22. TOTAL DAY'S EXPENSE	$

NOTE ON REVERSE SIDE, THINGS THAT NEED ATTENTION. ATTACH RECEIPTS FOR ALL MATERIAL OR SERVICE PURCHASED.

This printed form should be filled out daily by the driver, one form for each truck. At the end of the month, the operating expenses of each truck should be totaled and placed under a summary form with the same listings on it so that the dealer has the monthly cost of operating each truck on his desk for analysis.

repairs mentioned herein, but the text gives them enough information to detect warning symptoms in truck operation so that they can report the irregularities immediately. Where drivers are able to make the needed adjustments and minor repairs, they should be asked to do this thus reducing the dealer's outlay for truck operation and maintenance.

——BREAD IS THE STAFF OF LIFE——

Bevel and Miter Gears

Spur gears are used to transmit power from one shaft or element to another in cases where those shafts have their axes parallel. So-called bevel gears are employed where it is necessary or desirable to transmit power from one shaft to another where the communicating shafts are located at a right angle, with their extended axial lines intersecting. In cases where the ratio of a pair of bevel gears is 1 to 1, both gears being the same size and having the same number of teeth, they are known as miter gears.

It is entirely possible to make so-called angle gears just as readily as bevel gears can be made. Wherever a pair of gears is used to transmit power from one shaft to another, and where the two shafts have their extended axial lines intersecting at some angle other than 90 degrees, the gears are called angle gears. Thus, regardless of the particular angle (within a quadrant extending from zero to 90 degrees) at which a driving shaft is set with the driven, if the axial lines of the two shafts intersect when extended, a pair of angle gears can be readily made which will transmit power from one to the other. But while this is true, it is to be remembered that bevel or miter gears will not safely transmit as much horsepower as spur gears made of the same material and the same size.

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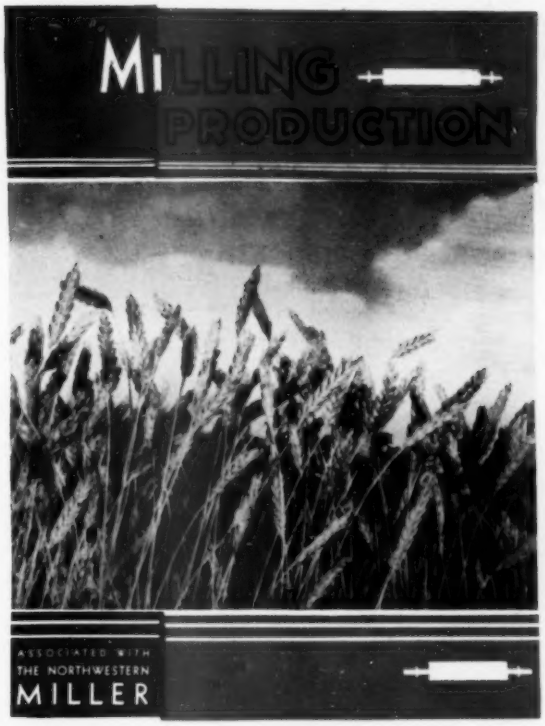

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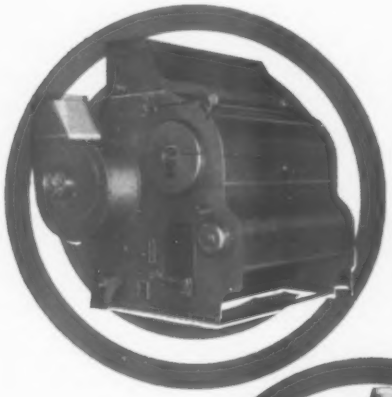
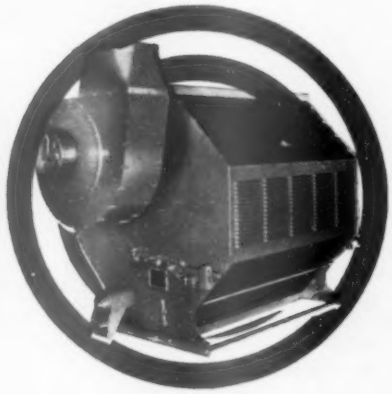


THE SCALPERATOR? The Carter Scalperator is primarily designed for receiving purposes. It will rough scalp and aspirate grain as it is unloaded ahead of storage; and it can be used to open up and aerate grain being turned for cooling. The Scalperator is a big capacity machine, available in capacities ranging up to 6,000 bushels per hour. Only 5 H.P. is needed for the largest machine . . . less than 1 H.P. per thousand bushels handled. A basic feature of the Scalperator is the unique "squirrel cage" scalping reel, so designed that roughage is scalped off without loss of good grain.



THE MILLERATOR? The Carter Millerator is most commonly used at the head of the cleaning systems. Here it efficiently performs secondary scalping operations, removes sand, dust, seed, and light screenings by dependable screening and thorough aspiration. The machine requires small space and very little power. Outstanding features that contribute to its high operating efficiency and low operating cost are: its ball and bevel self-cleaning screens which assure uniform results and require no attention; its mechanical removal of dust and fine screenings which requires a smaller air volume; its well-balanced aspirating system which provides accurate, easy control.

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